WATER QUALITY AND QUANTITY SURVEY
WHITEFISH AND DEN-LOU AREAS
TOWN OF WALDEN

1978

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INTRODUCTION

In response to a request by the Regional Municipality of Sudbury, the Municipal and Private Abatement Section of the Ministry of the Environment conducted a water quality and quantity study in the Whitefish - Den-Lou area from May 24, 1978 to June 13, 1978. A total of 168 residences representing 79% of the residences in the survey area were visited in order to assess sewage disposal methods and drinking water quality.

LOCATION

The area under study was subdivided into three sections: Whitefish East, Whitefish West, and Den-Lou.

Whitefish is located 27 Km west of Sudbury and has a population of approximately 650. Whitefish East encompasses all the streets adjacent to Highway 17 east of the M.T.C. storage yard up to and including the Bil-Mur Motel complex. Whitefish West includes all the streets adjacent to the highway west of the M.T.C. yard, incorporating the Westgate Motel, the Esso Service Station complex, and the dwellings located at the junction of Highway 17 and Highway 549.

The Den-Lou area is located at the Junction of Regional Road #4 (formerly Highway 658) and Highway 17 and has a population of 186.

An attached plan shows all streets involved in the study area (see Appendix A).

TOPOGRAPHY AND DRAINAGE

Bedrock ridges and drift-filled valleys are the characteristic topographical features of the entire study area. The soil type consists of clay in most areas. Sandy soil was noted in the most easterly portion of Whitefish.

The major drainage system is Junction Creek which flows from Kelly Lake draining westwardly through the study area and several connected lakes, namely Mud, Simon and McCharles Lakes to join the Vermilion River about 2.5 km east of Whitefish.

SURVEY PROCEDURES

The area under study was divided into three sections: Den-Lou, Whitefish West and Whitefish East. The field work was completed between May 24 and June 13 during which time the weather was hot and dry. The dates and number of homes surveyed in each area are listed below.

Thirty-eight out of 52 homes (73%) were surveyed in Den-Lou from May 24 to May 28, 1978. Twenty-nine out of 52 homes (56%) in Whitefish West were surveyed from May 29 to May 30, 1978. In Whitefish East, 101 out of 124 homes (81%) were surveyed from May 31 to June 13, 1978. This represents 79% of the total residences in the study area.

The field work conducted by staff consisted of the following procedures:

1. A questionnaire (see Appendix B) was completed at every residence.

2. For every residence, a plot plan of the house, well and sewage system was drawn and the property was inspected for malfunctioning systems.

3. Drinking water samples and ditch samples were collected and forwarded to the Sudbury and District Health Unit for bacteriological examination.

4. Samples of the drinking water were collected and forwarded to the Ministry of the Environment laboratories in Toronto for chemical analysis. The parameters measured consisted of hardness, alkalinity, iron, chlorides, pH, nitrates, colour, turbidity, and conductivity.

5. Eight samples of drinking water were collected for metal analyses: two from each of the Den-Lou and Whitefish West areas, and four from Whitefish East. The samples were forwarded to the Ministry of the Environment laboratory in Toronto for analyses. The parameters included arsenic, lead, copper, nickel, zinc, cadmium, and manganese.

WATER SUPPLIES

Questionnaire Results

The type and age of water supply systems in the study area are summarized in Tables 1 and 2.

TABLE 1

TYPES OF WATER SUPPLY SYSTEMS

SOURCE OF SUPPLY	DEN-LOU No.	DEN-LOU % of Total	WHITEFISH WEST No.	WHITEFISH WEST % of Total	WHITEFISH EAST No.	WHITEFISH EAST % of Total	TOTAL AREA No.	TOTAL AREA %
Drilled	12	32	7	24	16	16	35	21
Dug	25	66	20	69	79	78	124	73
Point	1	2	2	7	4	4	7	4
Vermilion River	0	0	0	0	2	2	2	1
Totals	38		29		101		168	

Of the 168 households surveyed, two homes in Whitefish East reported sharing a well with their neighbour.

Dug wells were the most popular supply source followed by drilled wells thoughout the entire area.

Approximately 48% of the well supplies were reported as being less than 10 years of age, 40% were over 10 years of age and for 12%, the person interviewed could not give the age. A significant percentage (45%) of the wells in Whitefish West were over 15 years old.

TABLE 2

AGES OF WATER SUPPLY SYSTEMS

AGE IN YEARS	DEN-LOU		WHITEFISH WEST		WHITEFISH EAST		TOTAL AREA	
	No.	% of Total	No.	% of Total	No.	% of Total	No.	%
0 - 5	8	21	4	14	33	32	45	27
6 - 10	15	39	7	24	14	14	36	21
11 - 15	3	8	1	3	11	11	15	9
> 15	10	26	13	45	29	29	52	31
Unknown	2	6	4	14	14	14	20	12
Totals	38		29		101		168	

Water quantity complaints are summarized in Table 3. Over the entire study area, 30% of well owners reported water shortages. Quantity problems occurred in dug wells to a significant degree. Drilled wells appeared to be far less susceptible to periodic shortages of supply.

Approximately half of those complaining of poor supplies over the entire area used wells over 15 years of age. This percentage ranged from a low 34% in the East to 75% in Whitefish West. It appears that the age of supply and the occurrences of quantity problems were associated to some degree.

TABLE 3

SUMMARY OF REPORTED WATER QUANTITY PROBLEMS

AREA	Number Reporting Low Quantity	Type of Well Dug	Drilled	*No. of Wells Older than 15 years
Den-Lou	11 (31%)	10 (91%)	1 (9%)	6 (54%)
Whitefish West	8 (28%)	7 (88%)	1 (13%)	6 (75%)
Whitefish East	32 (32%)	26 (81%)	6 (19%)	11 (34%)
Total Area	51 (30%)	43 (84%)	8 (17%)	23 (45%)

* Percentage of known well ages.

Sample Results

The assessment of water quality was made using the results of the sample analyses. The results of the bacteriological examinations and a summary of the chemical analyses of the drinking water are listed in Table 4 and Table 5 respectively.

TABLE 4

BACTERIOLOGICAL EXAMINATION OF DRINKING WATER SAMPLES

AREA	NO. OF SAMPLES	NUMBER OF SAMPLES WITH GREATER THAN 0 COLIFORM COUNTS	
		TOTAL	FECAL
Den-Lou	35	2 (6%)	0
Whitefish West	29	1 (3%)	0
Whitefish East	101	14 (14%)	3 (3%)
Total Area	165	17 (10%)	3 (2%)

As indicated in Table 4, only 3 (2%) of the 165 bacteriological samples of drinking water contained fecal coliforms. A somewhat higher percentage of total coliforms was detected. The owners of contaminated wells and the Health Unit were immediately contacted by letter. Overall, bacterial pollution of the Whitefish - Den-Lou area wells was considered to be insignificant as the counts as well as the number of water supplies with bacteriological counts were low.

Table 5 summarizes the results of the chemical analyses of drinking water samples. Hardness, iron, colour and turbidity levels were observed to be objectionable in a significant number of supplies.

TABLE 5

SUMMARY OF CHEMICAL ANALYSES OF DRINKING WATER SAMPLES

Area	Parameter	No. of Samples	Range	Average	Recommended Limit	Samples Exceeding Recommended Limit	
						Number	Percentage
Den-Lou	*Hardness	35	26-258	101	*180	6	17
	Alkalinity	35	13-268	64		0	0
	Iron	35	<0.05-8	0.8	0.3	15	43
	Chloride	35	<0.1-244	29	250	0	0
	pH	35	6.1-7.4	6.7	6.0-8.5	0	0
	Colour	35	<1-188	24	5	17	49
	Turbidity	35	0.25-72	7	1	22	63
	Conductivity	35	80-998	282		0	0
	Nitrate	35	<0.1-12	1.5	10	1	3
Whitefish West							
	*Hardness	29	39-873	319	*180	23	79
	Alkalinity	29	27-386	189		0	0
	Iron	29	<0.05-6.7	1.4	0.3	19	65
	Chloride	29	<1-462	91	250	4	3
	pH	29	6.6-7.7	7.3	6.0-8.5	0	0
	Colour	29	<1-124	27	5	18	62
	Turbidity	29	0.55-18	10	1	25	86
	Conductivity	29	95-2225	773		0	0
	Nitrate	29	<0.1-14	3	10	4	14

TABLE 5 (Continued)

Whitefish East							
	*Hardness	101	29-458	200	*180	53	52
	Alkalinity	101	18-386	112		0	0
	Iron	101	<0.05-8.0	0.77	0.3	30	30
	Chloride	101	<0.05-8.0	0.77	0.3	30	30
	pH	101	6.0-8.1	7.1	6.0-8.5	0	0
	Colour	101	0.9-142	16	5	52	51
	Turbidity	101	0.24-76	7	1	60	59
	Conductivity	101	116-1740	516		0	0
	Nitrate	101	<0.1-58	3.8	10	8	8
Total Area							
	*Hardness	165	26-873	200	*180	82	50
	Alkalinity	165	13-386	115		0	0
	Iron	165	<0.05-8.0	0.89	0.3	64	39
	Chloride	165	<0.1-462	59	250	8	5
	pH	165	6.0-8.1	7.0	6.0-8.5		
	Colour	165	0.9-1.88	20	5	87	53
	Turbidity	165	0.24-76	7.5	1	107	65
	Conductivity	165	80-2225	511		0	0
	Nitrate	165	<0.1-58	2.8	10	13	8

All analysis, except pH, Colour and Turbidity, are in mg/L

Colour - Hazen Units
Turbidity - Formazin Units

* Hardness - Greater than 180 mg/L of Calcium Carbonate ($CaCO_3$) is considered to be very hard water.

Nitrate concentrations exceeded this Ministry's permissible criteria in 13 supplies (8%). Since nitrate induced methemoglobinemia is a potential health hazard to infants under 3 months of age, well owners with excess nitrate were informed of the situation by letter.

Over the entire area nitrate contamination was not considered to be a serious health threat due to the low percentage of occurrences.

Of the eight samples of drinking water collected for metal analyses, 3 exceeded the manganese limit of 0.5 mg/L. All other parameters were within the acceptable limits.

SURFACE WATER QUALITY

Bacteriological examination of ditch samples in the Den-Lou area indicated low coliform organism counts at all 8 sampling points (see Map). Fecal coliforms, associated with the intestines of warm blooded animals and indicators of possible sewage pollution, did not exceed 32 organisms per 100 ml, well below the bathing beach standard of 100 fecal coliforms per 100 ml.

Two of the 4 Whitefish West samples contained slightly higher counts than those in Den-Lou. But with one exception, the results depicted low insignificant sewage contamination.

Of the 12 Whitefish East ditch samples, only one contained an elevated fecal count and the remaining 11 were virtually coliform free. Total coliform counts were consistently higher than in the other two areas and three of these could be considered significant. This was due in part to the steeper ditch gradients of the Whitefish East area which allowed a higher degree of soil erosion with the incidental addition of coliform bacteria to ditch waters.

In summary, 80% of the ditch samples contained low levels of fecal coliform matter, indicative of very slight sewage pollution of surface waters.

SEWAGE DISPOSAL

The types and ages of the sewage disposal systems in the area are summarized in the following two tables.

TABLE 6

TYPES OF SEWAGE DISPOSAL SYSTEMS

TYPE	DEN-LOU		WHITEFISH WEST		WHITEFISH EAST		TOTAL	
	No.	% of Total	No.	% of Total	No.	% of Total	No.	%
Septic Tank & Tile Bed	37	90	27	94	98	92	162	92
Holding Tank	1	2	0	0	0	0	1	0.6
Pit Privy	0	0	0	0	3	3	3	1.7
Lagoon	0	0	1	3	0	0	1	0.6
Leaching Pit for Wash water	3	8	0	0	5	5	8	4.5
Unknown	0	0	1	3	0	0	1	0.6
Total	41		29		106		176	

TABLE 7

AGES OF SEWAGE DISPOSAL SYSTEMS

AGE IN YEARS	DEN-LOU No.	DEN-LOU % of Total	WHITEFISH WEST No.	WHITEFISH WEST % of Total	WHITEFISH EAST No.	WHITEFISH EAST % of Total	TOTAL AREA No.	TOTAL AREA %
0 - 5	10	27	9	32	39	39	58	35
6 - 10	20	54	7	25	29	29	56	33
11 - 15	3	8	2	7	13	13	18	11
> 15	3	8	9	32	12	12	24	14
Unknown	1	3	1	4	8	8	10	6
Totals	37		28		101		166	

Note

Not including Holding Tanks, Lagoon, Leaching Pit for wash water.

Septic tank and tile fields accounted for 96% of the disposal systems. There were 3 pit privies, 1 lagoon, (serving R. H. Murray Public School), 1 holding tank.

The majority of the systems (68%) were less than 10 years old. Fourteen percent were over 15 years of age, the majority of these located in Whitefish West.

During the survey, sewage system problems were reported by residents or observed by staff at 24 (14%) of the houses. A summary of the types of problems are listed in the following table.

TABLE 8

SEWAGE SYSTEM PROBLEMS

TYPE OF PROBLEM	DEN-LOU		WHITEFISH WEST		WHITEFISH EAST	
	Reported	Observed	Reported	Observed	Reported	Observed
Direct discharge of sewage into ditch	0	0	1 (3%)	0	0	1 (1%)
Grey water discharge into ditch	0	2 (6%)	3 (10%)	3 (10%)	15 (15%)	16 (16%)
Septic tank block up/ overflow	0	0	0	0	4 (4%)	5 (5%)

All cases of reported and observed sewage and grey water discharges were reported to the Sudbury and District Health Unit for correction on an individual basis. Over 75% of the systems were operating satisfactorily at the time of inspection.

CONCLUSIONS

1. Bacteriological and chemical analyses of drinking water supplies did not indicate any significant health problems. Hardness, iron, colour and turbidity levels were observed in a majority of the wells, but these parameters are not health hazards and only affect the aesthetics of the supply.

2. The age and type of wells serving the Whitefish and Den-Lou area residents contributed significantly to reported quantity problems. Dug wells were associated with 84% of quantity complaints. No relationship between well depth and water shortages was observed.

3. Based on lot inspections and bacteriological analyses of surface water, subsurface sewage disposal systems were operating satisfactorily.

RECOMMENDATIONS

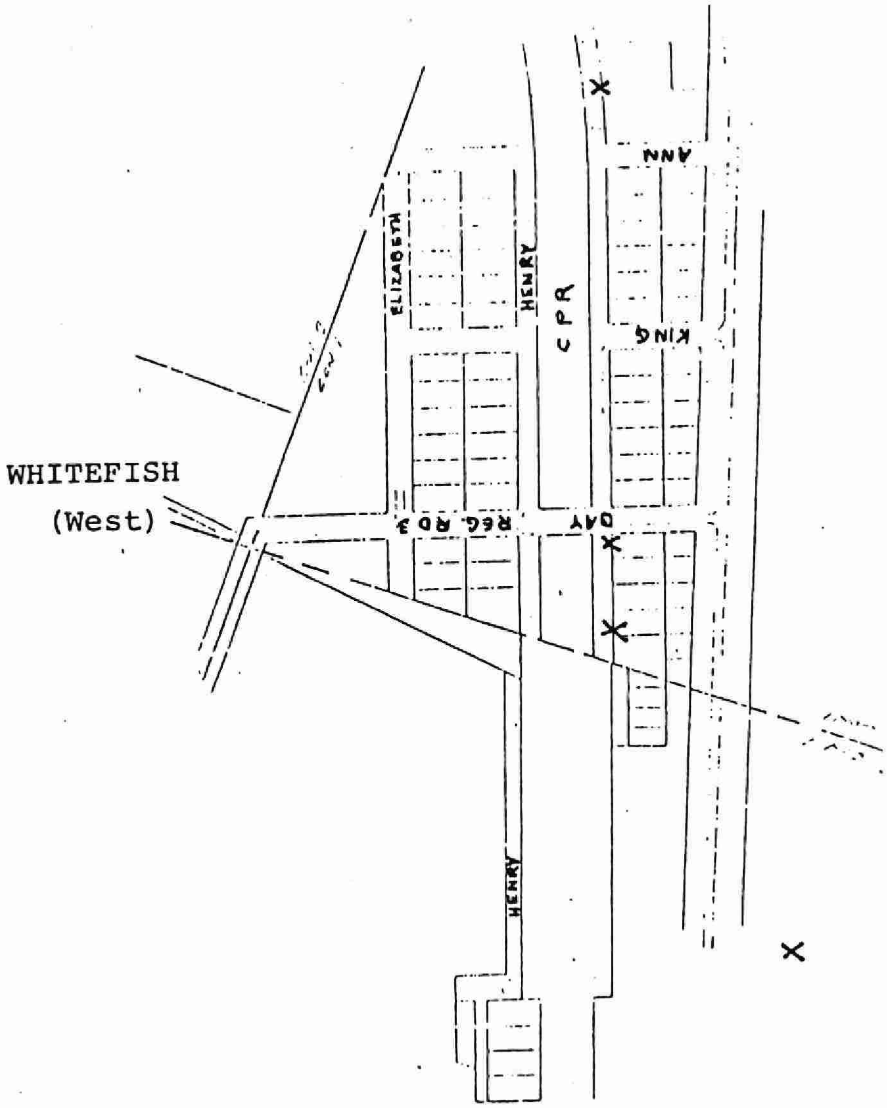
At this time, there are not sufficient health oriented problems to consider the groundwater in this area unacceptable for consumption.

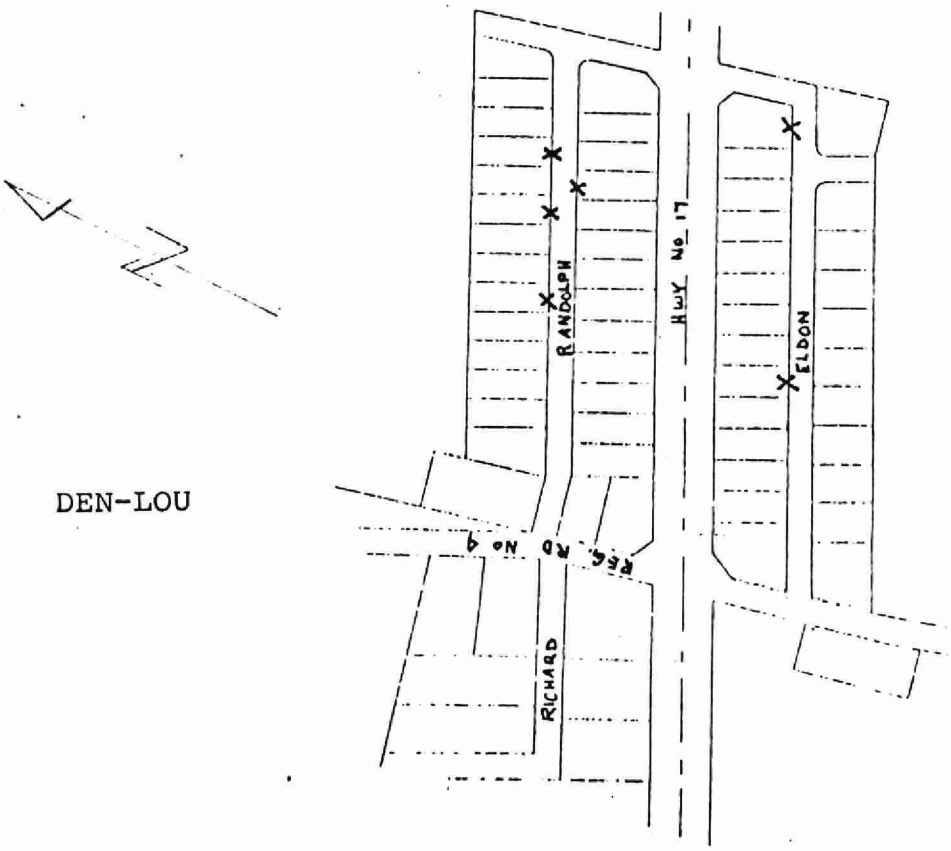
Property owners concerned about their well water quality and quantity should investigate corrective actions on an individual basis.

APPENDIX A
(i)

Maps of Study Area

X - indicates ditch sample location

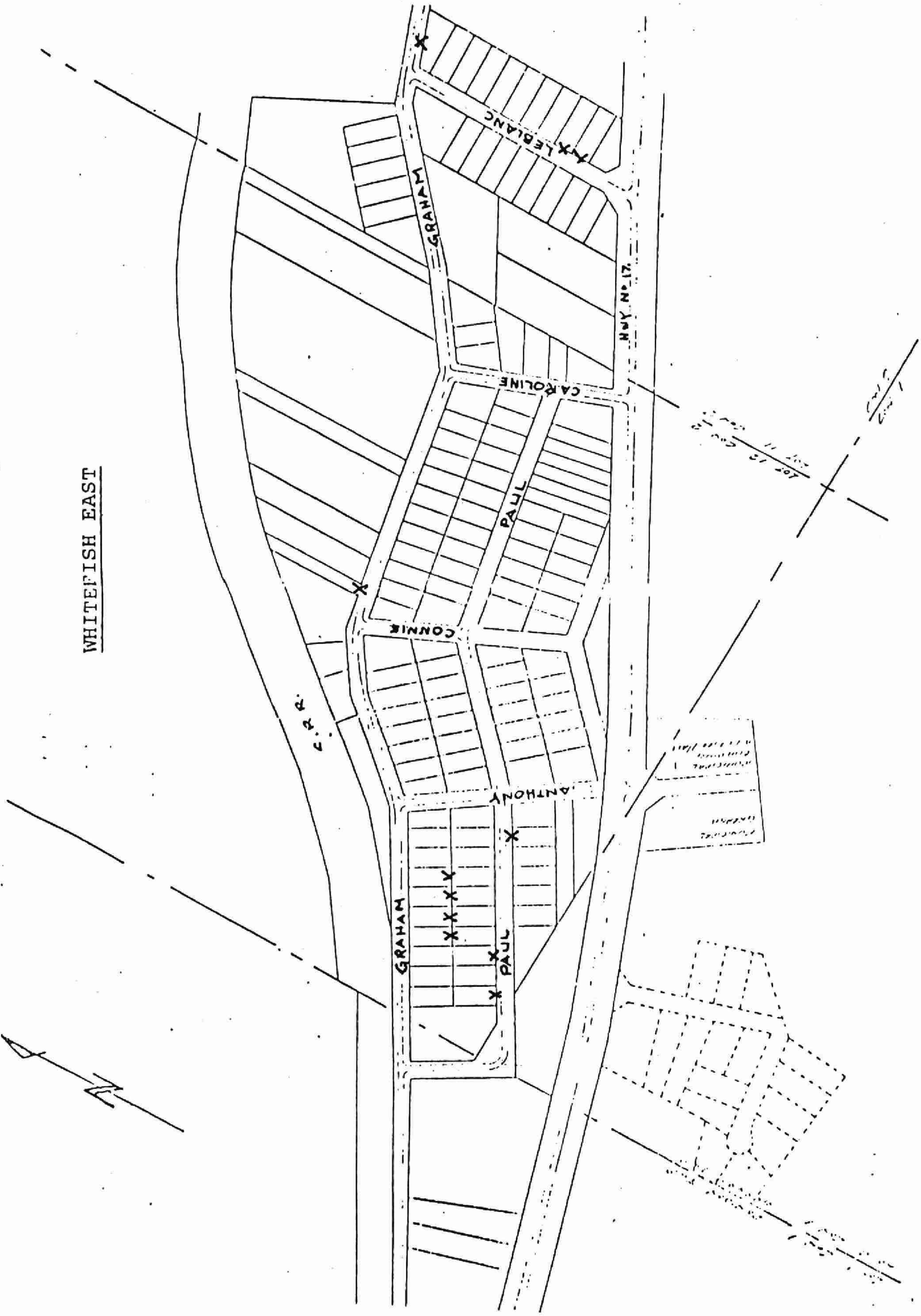




APPENDIX A

(ii)

WHITEFISH EAST



PRINT ALL INFORMATION

SURVEY FORM

APPENDIX B

COMMUNITY: __ __ ____________________

INFORMATION RECEIVED FROM: ____________________

SURVEYED BY: ____________________

SAMPLE INFORMATION

Type	Bacteriological		Chemical		
Sample No.					
Sample Location					
Results	Total	Faecal	Total	Faecal	

PROPERTY INFORMATION

Name of Owner ____________________ Owner's Phone No. __________

Permanent Address ____________________

Name of Resident ____________________

Lot No.	Conc.No.	Township	Community	Street Address	Phone No.

Size of Lot	Drainage	Topography	Soil Type

No. of Residents	No. of Bedrooms	Laundry Facilities	Other

SEWAGE DISPOSAL SYSTEM

Type	Septic Tank ______ Tile Bed ______ (enter distances)	Leaching Pit	Pit Privy	Other (Specify)

Age	Distance to Surface Water	Distance to Water Supply	

Comments: ____________________

	Note Quantity

WATER SUPPLY

Type	Surface Water	Dug Well	Drilled Well	Cased Well	Point

Depth	Age	Type & Capacity of Pressure System	Type of Pipe	Chlorinator	Filtration

Comments:	Taste	Odour	Colour	Iron	Hardness	Quantity	Quality	

DIAGRAM ON REVERSE SIDE SHOWING LOCATION AND DISTANCES FOR WATER SUPPLY AND SEWAGE DISPOSAL.

Appendix C

GLOSSARY

A. BACTERIOLOGICAL EXAMINATIONS

1. Coliform Bacteria

The direct search for a specific pathogen in water is too uneconomical and slow for routine control purposes. Instead water is examined for an indication of fecal contamination by using specific groups of bacteria as indicators. When these groups are found in the water it is assumed that the water is potentially harmful. The standard group of micro-organisms used as an indicator is the coliform group which includes all aerobic and facultative anaerobic, Gram-negative, nonspore forming, rod-shoped bacteria that ferment lactose with gas formation within 48 hours at 35°C. Organisms of the Escherchia coli strains which are usually of fecal origin, and of the intermediate and Aerobacter aerogenes strains which are usually but not always of soil, vegetable, or other non-fecal origin are included in this group.

1 (a) Total Coliforms

This group comprises species that are commonly associated with fecal matter (human and animal) and normal inhabitants of soil and vegetation. The presence of total coliforms in water may indicate contamination from soil runoff, or, less recent fecal pollution.

1 (b) Fecal Coliforms

These bacteria are mainly species associated with human and animal fecal matter. The presence of fecal coliforms in water indicates a relatively recent and near pollution input.

B. CHEMICAL ANALYSES

1. Alkalinity

Alkalinity is the measure of the power of a solution to neutralize hydrogen ions. It is used to define the buffering capacity (the capacity to resist changes in pH) of water. Alkalinity is expressed in terms of an equivalent amount of calcium carbonate. This does not necessarily imply that there is this much calcium carbonate in the water or that there is any at all. The alkalinity measurement represents the quantity of acid, expressed as calcium carbonate, needed to reduce the pH of a measured portion of sample 4.5. It is caused by the presence of carbonates, bicarbonates, and hydroxides, and to a lesser extent by the presence of borates, silicates, phosphates, and organic substances. Alkalinity is not considered detrimental to human health but it is generally associated with high pH values, hardness and excessive dissolved solids.

2. Colour - Apparent

Apparent colour includes colour due to dissolved solids and suspended matter. Surface water colour is due mostly to the presence of humic acids derived from decomposition of plant material. In groundwaters colour is usually due to the presence of iron and manganese. Most naturally coloured water (usually yellowish-brown) is harmless. The objective for domestic water supplies in Ontario is 5 Hazen Units.

3. Chloride

Chloride concentrations in water supplies may result from contact with natural minerals, industrial and agricultural wastes, or human and animal sewage. Urban runoff often contains high concentrations of chloride in the winter due to the application of road salt. Chlorides are generally not harmful. Allowable concentrations in drinking water are based on palatibility requirements rather than on health considerations. The water quality objective for domestic drinking water supplies in Ontario is 250 mg/L.

4. Conductivity

Conductivity is defined as the reciprocal of a water's electrical resistence (in ohms) between two electrodes one square centimeter in area and one centimeter apart at a standard temperature at 25°C. It is a measure of the ion concentration in water. In natural waters conductivity is mainly due to calcium, magnesium, sodium, potassium, bicarbonate, chloride, sulfate, and nitrate ions. Conductivity can be correlated with dissolved solids content. In Ontario the dissolved solids content is equal to 0.65 ± 0.10 times the conductivity. The permitted level for conductivity in drinking water in Ontario is indirectly established by the limit for dissolved solids.

5. Hardness

Hardness, defined as the soap neutralizing power of water, can be expressed in terms of an equivalent concentration of calcium carbonate. Hardness is mainly attributable to the presence of calcium and magnesium ions resulting from the natural accumulation of salts during contact with soil and geological formations. Hardness is objectionable because it reduces the efficiency of soap and it can produce scums and scales. Hardness in drinking water is limited indirectly by the criteria for dissolved solids (maximum of 500 mg/L). Concentrations over 120 mg/L become increasingly inconvenient.

6. Iron

Iron is the most abundant of the heavy metals in nature but despite this abundance it is generally found in relatively low concentrations in natural surface waters. In groundwater, however, conditions may be such that high concentrations of iron remain in solution. Iron concentrations occur in water due to the leaching of soluble iron salts from soil and rocks. Iron is non-toxic even at high concentrations but becomes objectionable in water because of the taste and odour it imparts. It also tends to precipitate as hydroxides staining laundry and porcelain fixtures. Also, ferric iron combines with the tannin in tea to produce a dark violet colour. The water quality objective for drinking water in Ontario (0.3 mg/L) is based on aesthetic and taste considerations.

7. Manganese

Manganese is a common element in nature and found in numerous minerals which include pyrolusite, braunite, manganesespat. It is essential in trace quantities for the proper nutrition of both plants and animals. Although manganese is non-toxic at levels commonly encountered in water supplies, it can cause unpleasant tastes and stain laundry and plumbing fixtures. Iron and manganese are commonly found together.

8. Nitrate Nitrogen

Nitrates are the end products of the aerobic stabilization of organic nitrogen and as such they occur in polluted waters that have undergone self-purification. They can occur in groundwater as a result of leachings from cesspools or fertilized soil. Photosynthetic action is constantly utilizing nitrates and converting them to organic nitrogen in plant cells but in groundwater this action is not possible and high concentrations of nitrates can result. Nitrates are undesirable because their nutritive properties promote the growth of algae and other aquatic plants. Although nitrates are considered non-toxic to adults, high levels in domestic water supplies can lead to a condition known as infant methemoglobinemia in which the oxygen carrying capacity of the blood is inhibited. The maximum acceptable level of nitrates for domestic water supplies in Ontario is 10 mg/L if the water is to be used for infant feeding.

9. pH

The symbol pH is used to designate the logarithm (base 10) of the reciprocal of the hydrogen ion activity. In the case of natural waters the hydrogen ion activity closely approximates the hydrogen ion concentrations in moles per litre. Although the hydrogen ion is a potential pollutant in itself, pH is also intimately related to the concentrations of many other substances. The degree of dissociation of many substances is influenced by pH and since the undissociated compounds are frequently more toxic than the ionic forms pH may be a highly significant factor in determining limiting concentrations. Also the hydrogen ion concentrations is important because it affects the taste and corrosivity of water and the efficiency of chlorination.

10. Sodium

Sodium ranks sixth in the natural order of elemental abundance and is normally the principal ion in brackish or saline groundwater. It is important for all life forms and is generally considered non-toxic. Patients with high blood pressure however are usually warned to avoid the consumption of water containing high concentrations of sodium. Waters softened by the ion-exchange process employed in most domestic water softening equipment, generally contain high levels of sodium.

11. Sulfates

Sulfates occur naturally in water as a result of leachings from minerals. Sulfates may also occur as the final oxidized stage of sulfides, sulfites, and thiosulfates, as the oxidized state of organic matter in the sulfur cycle and as a result of industrial wastes. Water high in sulfates tends to form hard scales on plumbing and increase the corrosiveness of water towards concrete. Under anoxic conditions sulfates serves as an oxygen source for bacteria which convert it to hydrogen sulfide gas. The maximum sulfate concentrations permissible for domestic water supplies in Ontario is 250 mg/L. Although the limit is not based on taste or physiological considerations, concentrations over the limist may exert a cathartic effect on the gastro-intestinal tract.

12. Turbidity

Turbidity is a measure of the optical properties of a water sample. It is attributable to suspended and colloidal matter which diminishes the penetration of light. Turbidity is useful in assessing water clarity. In Ontario turbidity is measured in Formazin Units.

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